

## **Title: Marathon Math**

### **Brief Overview:**

This task will enable students to predict, estimate, and accurately measure using a variety of activities and tools. The students will participate in a marathon of mathematical activities to see how closely their estimation compares to their actual measurements. They will become familiar with metric units by using their estimations and measuring. Upon completion of the activities, the students will use statistics and graphing to compare their individual results to the class results.

### **Link to Standards:**

- **Problem Solving** Students will use problem solving approaches to investigate and understand mathematical content. They will verify and interpret results with respect to the original problem solution and generalize solutions and strategies to new problem situations.
- **Communication** Students will use the skills of reading, listening, and viewing to interpret and evaluate mathematical ideas.
- **Reasoning** Students will recognize and apply deductive and inductive reasoning. They will make and evaluate mathematical conjectures and validate their own thinking.
- **Connections** Students will explore problems and describe results using graphical and numerical models.
- **Number Relationships** Students will understand, represent, and use numbers in a variety of equivalent forms in real-world and mathematical problems.
- **Computation Estimation** Students will use computation, estimation, and proportions to solve problems.
- **Statistics** Students will systematically collect, organize, and describe data. They will construct, read, and interpret graphs. They will make inferences based on data analysis.
- **Geometry** Students will represent and solve problems using geometric models.
- **Measurement** Students will extend their understanding of the measurement process. They will estimate, make, and use measurements to describe and compare phenomena. They will select units and tools to measure to the appropriate degree of accuracy, and they will understand the structure and use of measurement systems.

**Grade/Level:**

Grades 5-6

**Duration/Length:**

Two or three class periods (45 minutes in length) will be needed to complete these activities.

**Prerequisite Knowledge:**

Students should have working knowledge of the following skills:

- Estimating
- Calculation of mean, median, mode
- Graphing
- Ability to measure using metric units of length, volume, and mass.

**Objectives:**

Students will:

- work cooperatively in groups.
- collect, organize, and compare data from the activities.
- represent and use numbers in a variety of ways.
- estimate and measure accurately.

**Materials/Resources/Printed Materials:**

- Feathers
- Calculators
- Student worksheets
- Mini-marshmallows
- Sponges
- Buckets of water
- Straws
- Paper
- Balance
- Metric rulers and meter sticks
- Safety goggles
- Graph paper
- Math journal
- Calculators

## Background Information:

Before they do the activities of this unit, it is important that students have the necessary background. This section describes how to lay the groundwork for the Development/Procedures section.

The teacher will need to explain or develop the following terms:

- Mean: the sum of all data divided by the number of data; this can be introduced as another word for average.
- Median: the middle number or the mean of the two middle numbers when the data are arranged in order.
- Mode: the most frequently used number; there may be more than one mode.

Before measuring, do some activities involving estimation. For example:

- Ask students to estimate when 5, 10, or 30 seconds have elapsed.
- Have the students look at some optical illusions where lines of equal length don't look equal.
- Have students estimate which of several balled-up pieces of paper have more mass.

Also, it is important to do some introductory work with choosing the appropriate unit of measure. For example:

- Philadelphia is 250 kilometers away. Is this a measurement of length or distance?
- What unit would be appropriate for measuring the distance to the school cafeteria? (Meters, decimeters.) What unit is appropriate to measure your pencil? (Centimeters.) What unit would you use to measure the distance from school to the beach? (Meters, kilometers.)

In each of the following examples, tell which unit would be the appropriate one to use.

DISTANCE: kilometer, meter, centimeter, millimeter

MASS: kilogram, gram, milligram

VOLUME: liter, milliliter

TIME: year, hour, minute, second

TEMPERATURE: degree

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|--|---------------------------------------|
| 1. The distance from the school to the beach | 9. The height of a student            |
| 2. The mass of a hamburger                   | 10. The length of a football field    |
| 3. The age of a teenager                     | 11. The mass of a truck               |
| 4. The temperature of ice                    | 12. The length of an eyelash          |
| 5. The length of a pencil                    | 13. The temperature of a cup of cocoa |
| 6. The mass of a car                         | 14. The volume of a can of soda       |
| 7. The volume of a car's gasoline tank       |                                       |
| 8. The duration of a math class              |                                       |

Using the following list of Metric System units complete the following:

MILLILITER, GRAM, CENTILITER, LITER, KILOMETER, MILLIGRAM, KILOGRAM, DECAMETER, MILLIMETER, DECIGRAM, KILOLITER, DECAGRAM, CENTIMETER, METER, DEKAMETER, HECTOMETER, CENTIGRAM, DECIMETER, HECTOGRAM, DECILITER, HECTOLITER

1. List all 7 units that measure MASS.
2. List all 7 units that measure VOLUME.
3. List all 7 units that measure LENGTH.
4. Which is the largest unit of MASS?
5. Which is the smallest unit of MASS?
6. List all 7 units of MASS; from largest to smallest.
7. Which is the largest unit of VOLUME?
8. Which is the smallest unit of VOLUME?
9. List all 7 units of VOLUME from largest to smallest.
10. Which is the largest unit of LENGTH?
11. Which is the smallest unit of LENGTH?
12. List all 7 units of LENGTH from largest to smallest.
13. Name the 3 basic units of the Metric System.

(The activity above was taken from an activity from another school. We cannot locate the name of the author.)

### **Development/Procedures:**

For each day's activity, the students are to work in groups of 4 or 5. One person will read the instructions for the activity to members of his/her group. It is important for each student to understand that *before* each activity begins, he/she needs to record his/her estimate on the student score sheet. After each student performs the activity, he/she measures and records he/her actual length, mass, or volume. After all the stations have been completed by all groups, each student will find the score, which is the difference between the estimates and the actual measurement for each activity.

#### **Day 1:**

- All students are to wear safety goggles.
- Students are to do the football field goal activity with graphing exercise.
- Students will calculate the mean, median, and mode of the class results. This will be a teacher-directed activity.

#### **Day 2:**

- Students will do the Mini-Marshmallow Toe Grab activity in groups of four. When everyone is finished, the class will compare all the students' data.

**Day 3:**

- All students will wear safety goggles.
- Students are to do the feather throw and the Spit Ball Blow activities.
- After graphing and discussion is complete, the teacher will record each student's data for exact measurement on the board. Students are to calculate the mean, median, and mode for the class.

**Day 4:**

- Students will do the Sponge Suck Up activity. Discussion will follow.

**Day 5:**

- Students will display their graphs for each activity in a designated section of the room. Discussion will follow.

**Performance Assessment:**

Assessments are included at the end.

**Extension/Follow Up:**

- Estimate the number of liters of water that will fill your bathtub to a certain point.
- Arrange containers and/or objects in order from least to greatest in volume and mass. Make a diagram of the results or illustrate the data.

- **Measurement Project**

Design a system of linear measurement that can be used anywhere, such as in any country, with people who have different levels of education. Construct a sample kit for your measurement system. Each kit should include at least:

- a working model of your measuring tool
- a set of instructions telling how to use your tool and system
- an attractive package to hold your sample

You also might want to include:

- a price list for the cost of your system in the U.S. and/or other countries
- advertising appropriate for newspapers, television or radio
- anything else you can think of that would be helpful or interesting to include in a sample kit

For ideas to introduce measurement using volume, mass, and length, refer to:

*Metric Measuring and More Metrics*

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## FOOTBALL FIELD GOAL ACTIVITY

**Materials needed:** Plain white piece of paper (to construct football)  
1 piece of graph paper per group  
Pencil  
Ruler  
Goggles  
Masking tape

### Part 1:

- With your teacher, discuss the NFL Field Goal Statistics.

### Part 2:

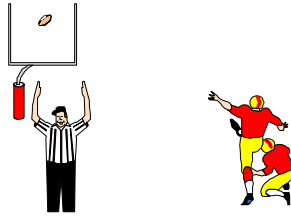
- Following your teacher's instructions, construct one paper football.

### Part 3:

- Your teacher will divide you into groups of 4. In your group, measure a 3 foot length on the top of your table or on the floor and mark each end with about 12 inches of masking tape.

Each member of the group will be assigned one of the following roles for the first rotation of goal shooting. When a shooter has finished, each group member will then take another role. This will continue until all members have had an opportunity to shoot.

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|--------------------|---|
| <b>A. Shooter</b>  | Attempts to shoot/kick 15 field goals through the goals established by the goalie.  |
| <b>B. Goalie</b>   | Holds the goal for the shooter. The goalie will place his/her elbows on one of the taped lines with a 12 inch ruler held between the palms. A goal is scored if the football is shot anywhere between the vertical lines established by the goalie's arms. If the football hits the ruler but does not go on through the arms of the goalie, it should be counted as a goal. The goalie must wear the goggles for eye protection. |
| <b>C. Referee</b>  | Judges and counts the successful attempts and calls out the results to the recorder.  |
| <b>D. Recorder</b> | Tabulates and records the successful shots on the data sheet.   |



### DATA TABLE

(use tally marks to indicate successful shots)

Complete with your group:	<u>Total Goals</u>	<u>Total Attempts</u>
Student #1: _____	_____	_____
Student #2: _____	_____	_____
Student #3: _____	_____	_____
Student #4: _____	_____	_____
GROUP TOTAL:	_____	_____

( This activity was borrowed from the Maryland Assessment Consortium)

#### Part 4:

- 1. On one side of the provided graph paper, make a bar graph showing the successful field goal results for each student. Label the graph properly with  $x$  and  $y$  axis labels and units. Be sure to title your graph.
- 2. Use your data table to calculate the percentage of each student's successful field goal shots. Round your answer to the nearest whole percent.

Student #1: \_\_\_\_\_%

Student #2: \_\_\_\_\_%

Student #3: \_\_\_\_\_%

Student #4: \_\_\_\_\_%

- 3. On the other side of the provided graph paper, make an unordered and ordered stem and leaf plot of the percentage statistics. Be sure to label it correctly.



### Part 5:

- If you saw your bar graph of the successful field goal results for your group in the morning paper, how would you explain it to someone who does not understand a graph?

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- If you were teaching someone, what instructions would you give them to figure field goal percentages?

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### Part 6:

- You have just been hired by the Washington Redskins as the new field goal kicking coach. You begin by scouting local colleges for their best kickers. You have determined that several kickers are very good and you want to put them on the Redskins team. Using your knowledge about field goal percents, write a letter to Redskin's owner Jack Kent Cooke. Tell him why you should hire the kickers. Make sure you include specific statistics and have proper letter form. You may write a rough draft on your own paper first. Your final draft will be written below.

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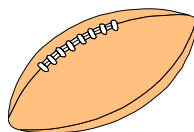
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## Part 7: Assessment

Complete the “Self” column of this chart by evaluating the work you have done on this activity.

<u>ELEMENTS</u>	<u>POINTS POSSIBLE</u>	<u>SELF</u>	<u>TEACHER</u>
<u>DATA:</u>			
Data table complete	5	_____	_____
Statistics accurate and complete	10	_____	_____
<u>GRAPH:</u>			
Correctly labeled	10	_____	_____
Units appropriate	10	_____	_____
Accurate graphing of data	20	_____	_____
Neat and easy to read	10	_____	_____
<u>QUESTIONS AND PARAGRAPH:</u>			
Shows clear understanding of data	10	_____	_____
Letter written in correct form	15	_____	_____
<u>GROUP ACTIVITY:</u>			
Worked well in a group	5	_____	_____
Followed directions	5	_____	_____
TOTAL POINTS POSSIBLE:	100	TOTAL EARNED:	_____



### **MINI MARSHMALLOW TOE GRAB**

1. With either our left or right bare foot, grab as many mini-marshmallows from the container as possible. Put them in a pile on the floor.
2. Estimate (in grams) the mass of the marshmallows in your pile and record this in your journal.
3. Place the marshmallows on a balance scale and measure the actual mass.
4. Record the data in your math journal.
5. Graph estimates and exact measurements.

### **FEATHER THROW**

1. Stand behind a taped line on the floor.
2. Estimate how far you can throw the feather (in cm). Record in your journal.
3. Throw your feather as far as possible.
4. Measure and record the exact distance in your journal.
5. Repeat one more time
6. Graph estimations in one color and actual distances in another color.

### **SPONGE SUCK UP**

1. Soak your sponge in a bucket of water.
2. Squeeze your sponge into another container.
3. Estimate (in liters) the amount of water your sponge held. Record in your journal.
4. Measure the amount of water your sponge held. Record in your journal.
5. Graph your estimate and exact measurement.

### **SPIT BALL BLOW**

1. Wad up a small amount of notebook paper (small enough to move through a straw).
2. Stand behind a taped line on the floor.
3. Estimate the distance (in meters) that you think you can blow the spit ball.
4. Shoot the spit ball through the straw by blowing hard.
5. Measure the distance and record in your math journal.

## **RUBRIC FOR JUDGING GROUP OR INDIVIDUAL STUDENT WORK**

This is a general rubric that may be used to assess the overall quality of the student's work. Attention is given to mathematical thinking, reasoning and communication.

### **PERFORMANCE INDICATORS**

#### **Level**

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|---|--|
| 6 | --Student completely accomplishes the task and goes beyond to extend the task to new dimensions or problems.<br>--Student shows in-depth understanding of the task.<br>--Student's communication is clear and dynamic and uses a variety of communication tools to do so.                                  |
| 5 | --Student completely accomplishes the task. All of the mathematics involved in the task is correct.<br>--Students shows a thorough understanding of the task.<br>Student's communication is effective.   |
| 4 | --Student accomplishes a substantial part of the task.. There may be a few parts missing and/or incorrect.<br>--Student shows a satisfactory understanding of the task. Major concepts are understood but understanding of less important ideas my be missing.<br>--Student's communication is successful. |
| 3 | --Student partially accomplishes the task. Some important parts may be completed, but there are definitely parts not completed or misunderstood.<br>--There are gaps in the student's understanding.<br>--Student's communication is limited. The results may be incomplete or poorly presented.           |
| 2 | --Student minimally accomplishes the task. Much of the work is misunderstood or misdirected.<br>--Student's understanding is fragmented. Results may be incomplete or reasoning weak.<br>--Student attempts to communicate.  |
| 1 | --Student does not accomplish the task.<br>--Student shows little understanding.<br>--Student's communication is nonexistent or unrelated to the task.   |

This was adapted from *A Sampler of Mathematics Assessment*, by Tej Pandey  
California Department of Education, Sacramento, CA 1991.